COSMIANTHEMUM: A BORNEAN GENUS OF ACANTHACEAE

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A few years ago Dr. C. E. B. Bremekamp described 8 species of a new Bornean endemic genus of Acanthaceae, which he named *Cosmianthemum* (Blumea 10: 166–1: 1960). When Burtt and Woods visited Sarawak in 1962, some attention to the forest Acanthaceae fitted in well with the main objective of the trip, the collection of Gesneriaceae. They were not familiar with Bremekamp's publication at the time, but the plants that were later found to be *Cosmianthemum* soon attracted attention and five collections, representing four species, were made. In addition one very different looking plant was repeatedly seen on Gunong Gaharu but only in the vegetative condition; it was eventually sent home with the living Gesneriaceae, more from sheer irritation than from any expectation that it would prove of interest. It flowered at Edinburgh and seems to be a new species of *Cosmianthemum*, though certain peculiarities lead us to call it *C. anomalum*. The naming of these plants has led to a general study of the genus. Pollen morphology is dealt with separately in an appendix (p. 379) by D. M. Henderson, to whom we are greatly indebted.

Bremekamp's work was chiefly based on collections made by Miss W. A. M. Brooke during her 1954/55 expedition to Sarawak. We have been able to examine a much wider range of material, including several gatherings from Indonesian Borneo, some bearing Hallier's manuscript names under *Sphinctacanthus*. Most important, however, were those specimens found in the Kew herbarium at the end of *Sphinctacanthus*. These sheets (mainly Haviland & Hose's Sarawak collections) had long ago been annotated as a new genus by Dr. Otto Stapf, but unfortunately his manuscripts have not been found. We have retained Stapf's generic name as the epithet for one of the new species, *C. dido*. Most of these sheets also bear a second series of MSS names given by C. B. Clarke, who apparently considered that these plants could be included in *Sphinctacanthus*. This is a genus which would seem to deserve critical re-examination. It might then prove to be more nearly related to *Cosmianthemum* (placed by Bremekamp near *Pseuderanthemum*) than to the genera of *Odontonemeae* where it was placed by Lindau (in Engler & Prantl, Natürl. Pflanzenfam. 4 (3b), 337: 1895). Superficially *Sphinctacanthus* resembles *Cosmianthemum* in the terminal inflorescence composed of flowers with small bilabiate corollas; but the constricted corolla tube, lack of staminodes and the median insertion of the filaments separate it. *Sphinctacanthus* has not been recorded from Borneo.

Bremekamp considers *Cosmianthemum* to be allied to *Pseuderanthemum*, from which it differs in the small flowers, emarginate or bi-lobed upper lip, thinness of the wall of the pollen grains and the nearly smooth testa. The similarities are the high insertion of the fertile stamens and the closely-adjacent staminodes and pollen grains. *Cosmianthemum* is therefore placed in the tribe Justiceae (sens. Brem.) or Pseuderathemeae Lindau (Engler & Prantl, Nat. Pflanzenfam. 4 (3B), 329: 1895) or Odontonemeae subtrib. Pseuderantheminae H. Melchior (Syllabus der Pflanzenfam. 12 Aufl. 2: 460 (1964)).

The name which Bremekamp has chosen for this genus, *Cosmianthemum*—the modest flower—is certainly very appropriate in its family. The small size of the corollas and their lack of colour (they are wholly white, or greenish- or yellowish-white, without markings) set the genus sharply apart from other Acanthaceae. In the field the long inflorescences with well-spaced groups of these exceptionally small flowers make the genus, once known, easy to recognise, but on the first encounter it may not be quickly attributed to the right family unless the characteristic acanthaceous capsules are present. *Cosmianthemum* is found in damp forest soil where the shade is not too dense, obvious differences between the habitats of the species were not noticed except for *C. anomalum* which is a dwarf plant creeping on mossy boulders.

One curious feature of the inflorescence seen in some specimens must be mentioned. In several species, but never constantly, the cymes which compose the inflorescence bear more than the usual one to three flowers. These extra flowers are developed with a quite small elongation of the axis of the cyme, but with a relatively marked thickening of it. The resultant almost cone-like structure is shown in Fig. 3 and something of the same nature can be seen in the illustration of *C. anomalum* (Fig. 2).

Linear cystoliths are present in all species except *C. anomalum* and the unnamed Clemens specimen from Mt. Kinabalu. In neither of these have any been observed as yet. *C. dido* is distinguished by having very short cystoliths, only 0·15–0·2 mm long—whereas they may be up to 0·5 mm in the other species.

Bremekamp's key rests rather heavily upon vegetative characters, particularly indumentum. It is, however, by no means easy to use with confidence and we think it more convenient and botanically more satisfactory to utilise the shape of the corolla-tube for the first division of the key.* In four species the tube is more or less parallel-sided; this group includes two subglabrous, green-leaved species and two with conspicuous white indumentum, the species are all readily distinguishable. The second group is composed of five species in which the corolla bears a dorsal pouch at least half-way up the tube, a character often easily seen in dried material without the need for dissection. In other respects too the flowers of these five species are very similar and show no specific characters; their details have been omitted from the accompanying short descriptions. With the exception of the almost glabrous *C. brookeae*, these are all plants which possess a brown tomentose, rather shaggy indumentum on stems, petioles and the nerves of the lower leaf surface.

It is in this group of species that satisfactory distinguishing characters are most difficult to find. Typical *C. obtusifolium* (a dwarf plant with rounded leaves) is clearly distinct and there is a second species with acute or acuminate leaves and large (for the genus) persistent bracts, *C. magnifolium*. *C. latifolium* and *C. angustifolium* are more problematic; in certain respects they resemble each other, both possess the small bracts and longer petioles of *C. obtusifolium* but in general facies *C. latifolium* is not unlike *C. magnifolium*. The proportion of capsule to stipe is of some importance in this group but material has been inadequate for a complete survey of this character.

* Nevertheless, it will be noted that the groupings obtained on corolla-form are not the same as those given by the union of the colpoid streaks on the pollen grains (see appendix).

In each of *C. magnifolium*, *C. obtusifolium* and *C. subglabrum* we have included specimens showing a range in leaf-size and stature which would normally be considered too wide for one species. Especially in *C. obtusifolium*, however, there are several intermediates and the examination of isolated herbarium specimens gives no clue to distances or differences in habitat which may separate populations of the contrasting forms. We have tried to set out the simplest classification, from which further studies may be carried forward: no purpose would be served by recognising additional "species" on the basis of one or two herbarium specimens with exceptionally large leaves.

Bremekamp described eight species of this genus, but we have reduced this number to six, and that may still be too many. The total is, however, raised to nine by the description of two new species, *C. anomalum* and *C. dido*, and the inclusion of N. E. Brown's *Dianthera bullata*.

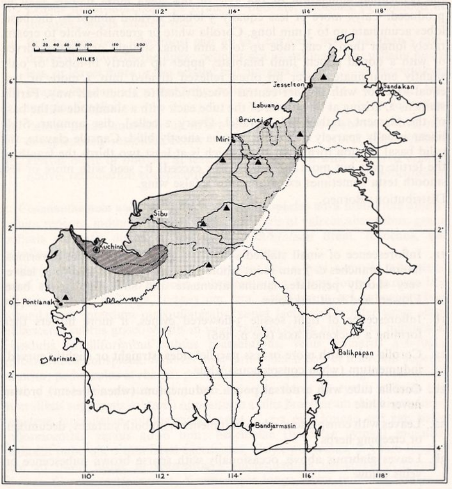


FIG. 1. Distribution of Cosmianthemum.
General area of genus dotted, actual localities marked with black triangles except in darker shaded area where they are numerous.

The map (Fig. 1) brings out the way in which this genus is restricted to western Borneo and has its maximum diversity in the southern part of Sarawak. This area is known to be one of the richest parts of the island in terms of species, a point brought out, for instance, by Airy-Shaw in his treatment of Thymelaeaceae-Gonystyloideae (Flora Malesiana, 1 (4), 349: 1953).

The main characteristics of the genus may be summarised as follows:

Herbs of up to 65 cm, creeping or erect from a decumbent, woody base, usually unbranched, subglabrous or with conspicuous brown or white indumentum. Linear cystoliths present in all but one species (usually restricted to the upper leaf surface, but sometimes found below); patelliform glands present on lower leaf surface but not always easily seen. Inflorescence a long, narrow terminal raceme of cymules, rarely sub-axillary. Bracts and bracteoles present, flowers usually 1–3, borne in opposite sessile cymes, but owing to the occasional elongation of the axis of the cyme more flowers may be produced. Calyx more or less equally 5 lobed, divided almost to the base, lobes acuminate up to 3 mm long. Corolla white or greenish-white to cream, rarely longer than 1 cm, tube up to 8 mm long, straight or slightly curved or with a dorsal pouch, limb bilabiate, upper lip shortly bi-lobed or only slightly emarginate, lower lip often reflexed divided into 3 more or less equal lobes or with a wider central lobe divided to about half way. Fertile stamens 2, arising at the mouth of the tube each with a staminode at the base of the filament, anther cells parallel. Ovary 2 celled, disc annular. Style linear usually sparsely pubescent, stigma shortly bifid. Capsule clavate, the solid basal portion forming a stipe which is at least two thirds the length of the fertile part but more often equals or exceeds it; seed with more or less smooth testa sometimes extending into a false wing.

Distribution: Borneo.

Key to the species

1a. Inflorescence of small stalked somewhat zig-zag cymes, the lowermost lateral branches c. 7 mm long: whole plant more or less glabrous, leaves very shortly petiolate, lamina attenuate and subauriculate at base. Flowers and fruit unknown . . . . . . 10. *sp.*

1b. Inflorescence of tight sessile 3-flowered cymes, if more flowers then forming a thickened axis (see p. 366) 2

2a. Corolla tube with more or less parallel sides, straight or slightly curved; indumentum (when conspicuous) white.

2b. Corolla tube with a dorsal pouch, indumentum (when present) brown, never white 6

3a. Leaves with conspicuous white indumentum on both surfaces; decumbent or creeping herbs 4

3b. Leaves glabrous above, occasionally with sparse brown pubescence on veins below 5

4a. Lower lip comprising 3 more or less equal lobes, leaves up to 6 cm long, acute or sub-acute at apex, creeping herb with short indumentum on the stems . . . . 1. *anomalum*

4b. Lower lip with median lobe broader than laterals, leaves up to 17 cm long, acuminate apically, woody based herb with long indumentum on the stems . . . . 2. *dido*

5a. Filaments filiform, 3 mm long, pubescent; leaves ovate, cordate at base . . . . 3. *bullatum*

5b. Filaments flattened, up to 3 mm long, glabrous or sparsely pubescent; leaves narrowly lanceolate to broadly elliptic, attenuate at base 4. *subglabrum*

6a. Stem and petioles puberulo-pubescent, never tomentose; leaves attenuate or abruptly and narrowly rounded at the base . . 5. *brookeae*

6b. Stem and petioles with downwardly directed reddish-brown tomentose hair, leaves rounded at the base, never attenuate . . . 7

7a. Leaves lanceolate elliptic, acute or acuminate at the apex . 8

7b. Leaves linear-lanceolate or ovate or obovate, subacute or rounded at the apex, bracts under 2 mm 9

8a. Bracts persistent, lowermost pair up to 1 cm long, never less than 5 mm, decreasing towards the apex; petioles not exceeding 1 cm, usually much less, or leaves more or less sessile; leaf margins flat . 6. *magnifolium*

8b. Bracts deciduous 1·5 mm long or less; petioles up to 2 cm long; leaf margins inrolled . . . . 7. *latifolium*

9a. Leaves linear-lanceolate up to 2·1 cm wide; always glabrous above, not conspicuously reticulate below . . . . . 8. *angustifolium*

9b. Leaves ovate or obovate at least 3 cm wide, often with scattered bristles above, reticulation conspicuous below . . . . 9. *obtusifolium*

1. Cosmianthemum anomalum Burtt & Smith, **species nova** nulli arcte affinis; habitu repente, indumento brevi albo, cystolithis ut videtur absentibus, grana pollinis ecolpatis distincta. Habitu *C. obtusifolium* Brem. revocans, sed corollae forma et indumento facile distinguitur.

Herba repens; caules floriferi ad 25 cm alti, e basi ramosi, indumento brevi albo vestiti. *Folia* petiolis pubescentibus 3–8 mm longis; lamina late elliptica 2·5–6 cm longa, 1·25–3 cm lata, apice acuta vel subacuta, basi rotundata et interdum inaequilateralis, supra laete viridis inter venis albo-pubescens, subtus griseo-viridis in venis tantum dense alibi parce pubescens, glandulis patelliformibus subtus praesentibus, venis primariis 4–6-jugis, resticulatione conspicua. *Inflorescentia* terminalis, e basi et interdum superne ramosa; pedunculus et rhachis puberulus, usque ad 18 cm longus, internodiis basi 3 cm longis sursum ad 3 mm redactis; flores in cymis trifloris (vel lateralibus suppressis solitarii) oppositis in axillis bractearum rhachi producti; bracteae lanceolatae, pubescentes, saepe c. 2·3 mm longae sed eae basin inflorescentiae versus ad 6 mm; bracteolae (bracteae cymae) minutae; pedicelli puberuli, 2 mm haud excedentes. *Calyx* puberulus, 2–3 mm longus, fere ad basin usque in segmentis 5 subaequalibus lanceolato-acuminatis divisus. *Corolla* viridi-cremea, 8 mm usque longa, extra puberula; tubus c. 5 mm longus basi levissime inflatus; limbus bilabiatus, labio superiore ovato c. 2 mm × 2 mm leviter bilobato, labio inferiore c. 3 mm longo ad basin in lobis 3 subaequalibus reflexis 1–1·5 mm latis. *Stamina* fertilia 2,



FIG. 2. *Cosmianthemum anomalum* Burtt & Smith (*Burtt* B. 2671).
A, habit × 1; B, part of inflorescence × 4; C, corolla, dissected × 4; D, gynoecium × 4; E, ovary in longitudinal section × 6; F, part of older inflorescence (see p. 366) × 4; G, upper leaf surface × 3; H, lower leaf surface × 3.

sub ore tubo orientia; filamenta 1·5–2 mm longa, lata et plana, glabra vel basi parce puberula; thecae antheae parallelae. *Staminodia* 2, c. 0·5 mm longa, obtusa, prope basin filamentorum fertilium orientia. *Discus* anularis 0·5 mm altus. *Ovarium* glabrum 3 mm longum; ovula per loculum duo. *Stylus* filiformis, parce pubescens; stigma minute bifidum. *Fructus* ignotus.

TYPE: Sarawak, First Division. Bukit Gaharu, c. 70 miles from Kuching on the Simanggang road, 900 m; creeping on moss-covered rocks in rather open moss forest on very broken ground; sandstone; 2 viii 1962, *Burtt* 2671, cult. in R.B.G. Edinburgh C 3976 (holo. E).

Easily recognisable by the short white indumentum and creeping habit, *C. anomalum* displays certain important differences from other *Cosmianthemum* and may, in the light of future knowledge, prove to be misplaced here. In cultivation at Edinburgh for several years, the plant has failed to form fruit, and ovary sections do not prove conclusively that the capsule would be of the clavate type found throughout the genus. The absence of linear cystoliths in the leaves and of colpi on the pollen grains (if normal) are unusual. We feel, however, that in view of the clear affinities with this genus in floral structure, there is insufficient ground for its exclusion at the present time (Fig. 2).

2. Cosmianthemum dido Burtt & Smith, **species nova** corollae labri inferioris lobo mediano lateralibus distincte latiore et tubo intus minute pubescente ab omnibus speciebus recedit. Forma corolla et indumento albo *C. anomalum* revocans, sed pilis longioribus et habitu erecto etiam facile distinguitur.

Herba e basi decumbente adscendens, c. 30 cm alta, indumento albo; caulis pilis longis septatis piloso-tomentosus. *Folia* petiolo piloso 3–6 mm raro 10 mm longo; lamina elliptica-obovata, 11-17 cm longa et 4·5–7 cm lata, apice acuta vel acuminata, basi rotundata, supra fusco-viridis pilis 3–5 mm longis dispersis, cystolithis lineolatis brevibus paucis, subtus griseo-viridis venis primariis 7–10-jugis subtus prominentibus dense pilosis, alibi parce et breviter pubescentibus. *Inflorescentia* terminalis e cymulis racemosis; pedunculus pubescens 8–10 cm et rhachis pubescens 4–8 cm, internodiis 1–1·5 (–3) cm basi apicem versus 3–4 mm tantum. *Bracteolae* minutae pubescentes. *Flores* in axillis bractearum in cymis 1–3-floris, pedicellis 1–1·5 mm longis puberulis. *Calyx* 1–1·5 mm longus, fere ad basin partitus, segmentis anguste lanceolatis acuminatis plus minusve aequalibus extra pubescentibus. *Corolla* alba fauce maculis parvis purpureis notata, 1 cm longa, tubo recto extra pubescente intus etiam breviter pubescente 5 mm longo; limbus bilabiatus, labio superiore vix emarginato vel integro, inferiore in lobos tres haud ultra dimidium diviso, lobo medio lateralibus triente latiore. *Stamina* 2, filamentis 3 mm longis basi parce et breviter pubescentibus, antherae thecis paulo inaequalibus. *Ovarium* glabrum, stylo filiformi c. 3 mm longo, parce pubescente, stigmate minute bifido. *Capsula* glabra, clavata, 2 cm longa stipite 1 cm longo incluso. *Semina* 4×2·5 mm, plana.

TYPE: Sarawak, Fourth Division. Pengkalan Lobang to Niah Caves, pathside in primary forest, flowers white with small purple markings in the throat, filaments dull red, anthers greenish, 3 vii 1962, *Burtt & Woods* B1998 (holo. E).

SARAWAK: Fourth Division. Baram, *Haviland & Hose* 3518 (K).

The long white indumentum with which the plant is clothed makes this species immediately recognisable and the unequally 3-lobed lower lip is unique in the genus (Fig. 3, A–D).

We have taken as the specific epithet for this species the name which Dr. O. Stapf proposed to bestow on the whole genus. In doing so we must admit that we do not know the reason for Stapf's choice; nevertheless as the name is written in the herbarium, and as the Haviland & Hose specimen was one of those examined by Stapf, it seems appropriate to record his early recognition of the genus by making this use of the name he chose.

3. **Cosmianthemum bullatum** (N. E. Brown) Burtt & Smith, **comb. nov.**

Syn.: *Dianthera bullata* N. E. Brown in L'Illustr. Hort. 33: 43, t. 589 (1886).

TYPE: Borneo, without precise locality, cult. La Compagnie Continentale d'Horticulture, Gand, Belgium, 23 vi 1885 (holo. K). Cult. R.B.G. Kew, xii 1888 (K).

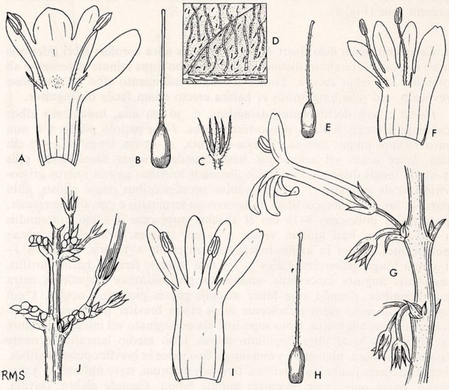


FIG. 3.

Cosmianthemum dido Burtt & Smith (*Burtt & Woods* B. 1998). A, corolla, dissected × 4; B, gynoecium × 4; C, calyx × 4; D, upper lead surface × 4 *C. bullatum* (N. E. Brown) Burtt & Smith (Cult. La Compagnie Continentale d'Horticulture, Gand); E, gynoecium × 4; F, corolla, dissected × 4; *C. subglabrum* Bremekamp (Burtt & Woods B. 1871); G, part of inflorescence × 4; H, gynoecium × 4; I, corolla, dissected × 4; J, part of older inflorescence (see p. 366) × 2.

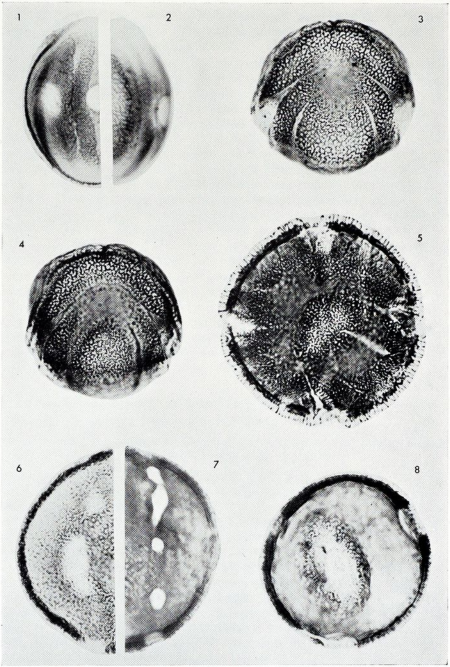


PLATE 37. Pollen grains in Cosmianthemum.
1, 2, *C. dido*, equatorial view; 1, optical section; 2, high focus. 3, *C. obtusifolium*; oblique polar view. 4, 5, *C. bullatum*; 4, oblique polar view; 5, optical section, polar view. 6, 7, *C. anomalum*, irregularly porate grain; 6, optical section; 7, surface view; 8, *C. anomalum*, 3-porate grain, optical section, polar view. All × 1000.

Resembling *C. subglabrum* in habit and indumentum, differing in the cordate leaf base, the lamina being bullate between the main nerves, and the filiform, pubescent filaments.

Erect herb, height unknown. Leaves shortly petiolate (c. 2 mm), lamina broadly elliptic 10 cm × 6–7 cm, acute at the apex and cordate at the base. Main nerves up to 12 pairs diverging from the mid-rib at c. 80°, bullate and glabrous between the nerves above, sparsely pubescent on the nerves below; linear cystoliths present on both surfaces. Inflorescence rather lax c. 30 cm long, flowers borne singly or 2 (rarely 3) together in the axils of 4–1 mm pubescent bracts, bracteoles minute. Pedicels up to 5 mm long; calyx puberulous 2 mm long divided almost to the base into 5 ± equal acuminate lobes. Corolla 5–6 mm long sparsely puberulous outside, tube 2·5–3 mm without a dorsal pouch, swelling slightly at the base; upper lip c. 2·5 mm × 1·5 mm slightly bi-lobed; lower lip divided into 3 ± equal 2·5–3 mm lobes. Fertile stamens 2, filaments 3 mm long, linear, pubescent, anther cells parallel. Staminodes 2, linear, c. 0·5 mm long. Style sparsely pubescent. Ovary glabrous. Fruit not seen.

No further records of this plant have been found. The cited sheets each consist of a single flowering inflorescence and the uppermost leaves only. The published illustration is of a vegetative shoot and shows clearly the affinity in both habit and indumentum with the following species, *C. subglabrum*. In his discussion Brown expressed doubts about its generic position and it is certainly very far removed from the American *Dianthera*, which lacks staminodes and bears anther cells at unequal levels.

4. Cosmianthemum subglabrum Bremekamp in Blumea, 10: 174 (1960).

Syn.: *C. punctulatum* Bremekamp in Blumea, 10: 173 (1960).

TYPE: Sarawak, First Division. Kuching, 1–2 ft under rubber, flowers tinged green, 13 xi 1955, *W. M. A. Brooke* 9679 (holo. L, iso. BM).

SARAWAK: First Division. Bako National Park: path from Telok Asam to Telok Paku, amongst mossy rocks at edge of path, flowers cream, plant normally unbranched, 20 v 1962, *Burtt & Woods* B1871 (E). Kuching, 13 xi 1894, *Haviland & Hose* 3545 (K, BM). Kuching, *Haviland* 575 (K). Kuching, vii 1865, *Beccari* 162 (K). Siol near Kuching, iv 1906, *Hewitt* 15 (K). Berumput, Poi Range, 900 m, 10 v 1954, *W. M. A. Brooke* 8594 (holo. *C. punctulatum*, L). Serian on the Sadong, 40 miles SE of Kuching in forest, 16 i 1955, *W. M. A. Brooke* 9556 (L). Lundu, flowers white, ix 1905, *Ridley* 12450 (K). Second Division. Simanggang on the Lupar, in wet forest, 31 x 1955, *W. M. A. Brooke* 10818 (L). Same locality, in very wet forest, flowers white, 27 x 1955, *W. M. A. Brooke* 10713 (BM). Betong, on ground under rubber, 3 iv 1954, *W. M. A. Brooke* 8296 (L; BM—excluding detached capsules).

KALIMANTAN: Pulau Bukit Tehemeng, NE of Santiang [c. 1° N, 112 °E], forest, flowers white, common, 10 x 1949, *Main* 2060 (E. Polak Expedition (L). Sungai Kenepai, [c. 0° 55′ N, 111° 40′ E], *Hallier* 2066 (L. K). Gunong Kenepai, [c. 0° 55′ N, 111° 40′ E], *Hallier* 1012 (L). Soeka Lanting, Kapuas delta near Pontianak, *Hallier* 175 (L). Singkadjang, Lake area [1°N 112°E], *Teysmann* 7925 (L). Without date or locality *Teysmann* 11502 (L), 11505 (L), 11508 (L, K).

Erect, occasionally branching herb up to 60 cm. Leaves bright green, narrowly lanceolate to broadly elliptic, acute or acuminate, attenuate at the base, petioles usually less than 1 cm; lamina 4·5–20 cm long × (0·75–) 1·5–9 cm wide, linear cystoliths conspicuous above generally present below; patelliform glands often conspicuous on lower surface; main nerves 6–30 pairs sometimes sparsely pubescent and anastomosing at the often undulating margins. Inflorescence terminal, rarely sub-axillary 7–12 cm long puberulous; bracts and bracteoles minute. Flowers borne on 1–2 mm pedicels in opposite fascicles of 2 or more, the fascicles sometimes peduncled. Calyx 2–3 mm long, puberulous, divided almost to the base. Corolla cream to greenish-white, puberulous without; tube lacking a dorsal pouch 6–8 mm long; upper lip scarcely bi-lobed, lower lip divided into 3 more or less equal lobes. Fertile stamens 2, filaments 1–2 mm long, usually glabrous but occasionally sparsely pubescent, flattened and 0·5–0·7 mm broad at the base, 2 staminodes c. 1 mm long glabrous. Style filiform, hirtellous, ovary glabrous. Fruit 2·2–2·8 cm long, including the 1–1·5 cm stalk.

Bremekamp's separation of *C. punctulatum* from *C. subglabrum* depends on 3 main characters: petiole length (under 3 mm in the former), reticulation of the lower leaf surface (lax in *C. punctulatum*) and the presence in *C. punctulatum* of patelliform glands on the lower leaf surface. Such glands are widespread throughout the genus and certainly not, as stated by Bremekamp, restricted to *C. punctulatum* and *C. angustifolium*. They are not always clearly visible without microscopic aid and are particularly difficult to distinguish when dense cystoliths are present on the lower leaf surface. Patelliform glands occur frequently in the Acanthaceae and were found to be present in *Linariantha* the vegetative similarities of which (shaggy indumentum and decumbent habit) with certain species of *Cosmianthemum* were indicated previously (Notes R.B.G. Edinb. 26: 325: 1965). Reticulation is very variable throughout the range of material examined, as is petiole length which may vary considerably within a single gathering. The leaves of the type of *C. subglabrum* are linear-lanceolate and this shape is generally maintained throughout the species. *Burtt & Woods* B1871, however, has some leaves which measure 9 cm in width but, as with petiole length there is variation within a single collecting.

The most easily recognisable features of *C. subglabrum* may be summarised:- The erect habit, lack of any *conspicuous* indumentum and the prominently nerved leaves which are *never* rounded at the base but merge gradually into the petiole. The affinity with *C. bullatum* has been stated. There may be another source of confusion for such vegetative characters might apply to the little known *C. brookeae* (in the dried state that species lacks the green leaves usually clearly seen in *C. subglabrum*) but flowering material of *C. brookeae*, showing the pouched corolla, leaves little doubt as to the true affinity of that species.

C. subglabrum appears to be restricted to SW Sarawak and NW and Central Indonesian Borneo. It has not been collected above 2° N.

5. Cosmianthemum brookeae Bremekamp in Blumea, 10: 172 (1960).

TYPE: Sarawak, Second Division. Lubok Antu on the river Lupar, 25 x 1955, *W. M. A. Brooke* 10681 (holo. L, iso. BM).

Suberect herb 20–25 cm, stems puberulous. Leaves with 3–6 mm puberulo-pubescent petioles, lamina linear lanceolate or lanceolate 9·5–11 cm long × 1·8–2 cm wide, acuminate or caudate acuminate at apex, suddenly rounded or attenuate at the base, main nerves 5–6 pairs conspicuous below, anastomosing at the margins. Inflorescence puberulous 8·5 cm–10·5 cm long, bracts up to 4 mm long. Capsule 1·5 cm long, including the 6 mm stipe.

As with the two preceding species, *C. brookeae* is almost entirely without indumentum. Bremekamp uses, as a key character "blade at the base suddenly rounded". This is only partially true, for the type (and only) specimen, which consists of two flowering shoots, also displays several leaves in which the lamina gradually merges into the petiole in the manner of *C. subglabrum*. The corolla, which is distinctly pouched, points to a truer affinity with *C. magnifolium*. This is in accordance with Bremekamp's views. The short stalked capsule (1·5 cm long, including the 6 mm stipe) is unusual; in all other species save *C. magnifolium*, where it may be slightly shorter, the stalk either exceeds the capsule in length or is more or less equal to it. The need for further material is obvious.

6. Cosmianthemum magnifolium Bremekamp in Blumea, 10: 168 (1960).

Syn.: *C. longibracteatum* Bremekamp in Blumea, 10: 171 (1960).

TYPE: Sarawak, Third Division. Nanga Mujong, near Kapit, at the junction of the Mujong and Baleh River, under trees above the river, flowers white, 4 viii 1954, *W. M. A. Brooke* 8934 (holo. L).

SARAWAK: First Division. Kuching, 2 ix 1894, *Haviland & Hose* 3544 (K, BM, L). Kuching, 1893, *Bartlett* s.n. (BM). Matang Road woods, flowers white, 2 i 1915, *Ridley* s.n. (K). Sudan, 11 ii 1914, *Native collector* D.15 (E). Second Division. Grajih Betong near Batang, on damp ground in old forest, 28 iii 1954, *W. M. A. Brooke* 8250 (holo. of *C. longibracteatum* L, iso. BM). Third Division. Pelagus Rapids on Rejang, greenish white flowers, 19 vii 1962, *Burtt & Woods* B2546 (E). Wong Pelagus on the upper Rejang River, on ground in wet forest, 14 ix 1954, *W. M. A. Brooke* 9302 (L). Kapit on the upper Rejang River, *J. & M. S. Clemens*, 21227 (K). Gat on Rejang River, *J. & M. S. Clemens* 21558 (K). Gilam Bakun, above Belarga on the Balu River, amongst rocks by the forest path, flowers cream, 23 viii 1954, *W. M. A. Brooke* 9074 (L). Fourth Division. Melinau gorge: stream tributary to S. Melinau about 2 miles above gorge camp; small cream flowers, young leaves with dark red hairs, 25 vi 1962, *Burtt & Woods* B2292 (E). Baram, without precise locality, vii 1894, *Haviland & Hose* 3543 (K). Fifth Division. Lawas on ground in the forest, flowers white, 29 v 1955, *W. M. A. Brooke* 10011 (L).

Stems to 40 cm high, often decumbent at base, brown tomentose, occasionally branching. Leaves on tomentose petioles not usually exceeding 0·5 cm (rarely up to 1 cm) lamina elliptic acute or caudate acuminate apically, obtuse at the base 4–21 cm long × 1·5–6·6 cm wide; upper surface glabrous linear cystoliths present, lower surface with 7–10 tomentose main nerves, anastomosing at margin. Inflorescence pubescent 10–30 cm long. The lowermost bracts up to 1 cm long but usually less reducing in size towards the top. Capsule c. 2 cm long, including the 0·9–1·1 cm stipe.

The conspicuous brown tomentose indumentum of this and three following species is not found in other members of the genus.

Bremekamp describes the stem hair of *C. longibracteatum* as "basiscopic" and that of *C. magnifolium* as "tomentose". The hairs found on all these plants (as in *C. latifolium*, *C. angustifolium* and *C. obtusifolium*) are downwardly directed.

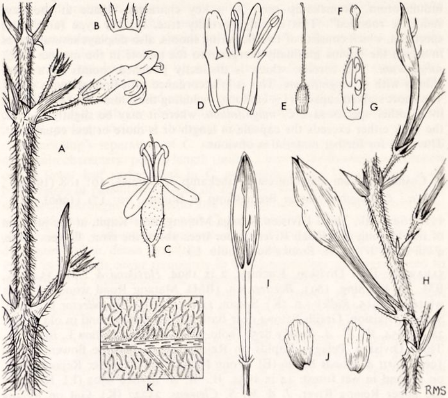


FIG. 4. *Cosmianthemum magnifolium* Bremekamp (Burtt & Woods B. 2292). A, part of inflorescence × 4; B, calyx × 4; C, flower × 4; D, corolla, dissected × 4; E, gynoecium × 4; F, stigma × 8; G, ovary in longitudinal section × 8; H, part of infructescence × 3; I, capsule in longitudinal section × 3; J, seed × 6; K, upper leaf surface showing linear cystoliths × 6.

The inclusion of *C. longibracteatum* within *C. magnifolium* seems quite justifiable. In his key Bremekamp states that the bracts of *C. magnifolium* are "small and easily overlooked" (his description, however, reads 3–6 mm), for *C. longibracteatum* we find "Bracts linear, the lower ones up to 9 mm long, towards the top of the raceme gradually decreasing to 2 mm". But the type of *C. magnifolium* bears a lowermost bract which is 1 cm long, i.e. longer than the majority of those found in *C. longibracteatum*. Such conspicuous bracts (at least 5–6 mm long at the base of the rhachis) are present in all but a few of the inflorescences examined, in related species they do not exceed 2 mm in length. It is on size alone that *C. longibracteatum* may be distinguished from *C. magnifolium*. *Brooke* 8938 (the type of *C. magnifolium*), *Brooke*

10011, *Haviland & Hose* 3543 and *Burtt* 2292 have leaves of up to 20 cm long and 6·5 cm wide; the remaining citations (which include Bremekamp's *C. longibracteatum*) comprise smaller, more delicate plants with leaf measurements not exceeding 9 cm × 3 cm. It is impracticable, at this stage, to complicate the classification of the genus with infra-specific groups which might presume a greater understanding than we have at present. There is a wide scope for careful field observation on size, habitat and distribution in this and other species.

C. magnifolium is widespread throughout Sarawak.

7. Cosmianthemum latifolium Bremekamp in Blumea, 10: 168 (1960).

TYPE: Sarawak, First Division. Kuching, on ground in low forest, 28 ii 1955, *W. M. A. Brooke* 9776 (holo. L).

SARAWAK: First Division. Sungei Raya, on ground in forest, 3 ix 1954, *W. M. A. Brooke* 9354 (L). Second Division. Simanggang on the River Lupar, in wet forest, x 1955, *W. M. A. Brooke* 10889 (L).

Stems up to 30 cm, often decumbent at base, brown tomentose. Leaves with tomentose petioles usually exceeding 0·7 cm, lamina elliptic 7·5–12·5 cm long × 3–5·5 cm wide, acute at the apex, rounded at the base, linear cystoliths present on the glabrous upper surface, patelliform glands usually uniformly present below, main nerves 6–8, tomentose below, conspicuously anastomosing at the inrolled margins. Inflorescence up to 15 cm long, terminal, pubescent. Bracts not exceeding 1·5 mm, deciduous. Fruit not seen.

In leaf shape, *C. latifolium* is similar to the preceding species (in which we were at first tempted to include it), but the longer petioles, strongly anastomosing veins and small deciduous bracts may serve for distinction and indicate an alliance with *C. angustifolium*. Ripe capsules, which in *C. angustifolium* bear unusually long stalks, would help to substantiate this, or indicate otherwise.

8. Cosmianthemum angustifolium Bremekamp in Blumea, 10: 169 (1960).

TYPE: Sarawak, First Division. Kuching, Stapok Road, beside ditch in forest, 11 xi 1954, *W. M. A. Brooke* 9422 (holo. L, iso. BM).

SARAWAK: First Division. Kuching, beside a footpath through the forest, 22 iii 1954, *W. M. A. Brooke* 8212 (L). Kuching on wet ground beside the path and in the forest, flower white, 15 iv 1954, *W. M. A. Brooke* 8374 (L). Kuching, 1 vi 1954, *W. M. A. Brooke* 8639 (BM). Matang Road, 30 vi 1924, *Mjöberg* 212 (BM). Matang Road, 3 i 1915, *Ridley* s.n. (K).

Stems 15–20 cm high, often decumbent at base, densely brown tomentose. Leaves with tomentose petioles 0·5–1·5 cm long; lamina linear or linear lanceolate 7–8 cm long × 0·9–2·1 cm wide, obtuse or sub acute at apex, rounded at the base, recurved at the margins; upper surface densely covered with linear cystoliths, patelliform glands uniformly present below; main nerves 5–7 pairs, brown tomentose conspicuously anastomosing at the margins. Inflorescence terminal up to 13 cm long or sub-axillary (in the type 1–4 separate peduncles arising from the main axis—probably the result of injury). Capsule 1·5–2 cm long including the 1–1·3 cm stalk.

The affinity of *C. angustifolium* with *C. latifolium* has already been stated. It is at present separated from that species on the smaller, linear or linear lanceolate sub-acute leaves. Known as yet only from a small area around Kuching.

9. Cosmianthemum obtusifolium Bremekamp in Blumea, 10: 170 (1960).

TYPE: Sarawak, First Division. Serian on the Sadung, 40 miles SE of Kuching, on ground in forest, 16 i 1955, *W. M. A. Brooke* 9560 (holo. L, iso. BM).

SARAWAK: First Division. Kuching, 17 ii 1894, *Haviland & Hose* 3542 (K, BM, L). Kuching, *Haviland* 574 (K). Sebanding, Lundu, procumbent herb, flowers cream, swamp forest, 18 ix 1955, *Purseglove & Shah* 4495 (K, L, SING). Telok Delima, Bako National Park, herb with creeping stem and erect branches to 1½ ft, corolla greenish white, forest, 60 m, 19 v 1956, *Purseglove* 4991 (L, SING). Bako National Park: Lintang path S of Telok Asam, before branch to Telok Delima, amongst rocks by stream, 19 v 1962, *Burtt & Woods* B1863 (E). Bidi, vii 1902, *Ridley* 11730 (K). Without precise locality, *Hullet* 728. Santubong, 3 viii 1924, *Mjöberg* 160 (BM).

KALIMANTAN: Sungai Kenepai, [0° 55′ N 111° 40′ E], *Hallier* 2010 (K, L). Landak Nyabang, *Teymann* 11497 (L). M. Geneya, *Teysmann* 7922 (L).

Herb, creeping or erect from a decumbent base, up to 45 cm tall stems unbranched, densely reddish tomentose; leaves with 1–4 cm tomentose petioles, lamina ovate-obovate, 4–16 cm long × 3–10 cm obtuse or sub-acute at apex rounded at the base, upper surface with scattered bristles or glabrous, linear cystoliths present, lower surface tomentose on the nerves, strongly reticulate; main nerves 5–9 pairs. Inflorescence terminal reddish-brown pubescent, 6–20 cm long. Bracts and bracteoles minute. Capsule c. 2 cm, including the 1·1 cm stalk.

In its small leaved creeping form, which Bremekamp described, *C. obtusifolium* is the most readily distinguished of this group. *Purseglove* 4491, however, displays leaves up to 18 cm long and 12 cm wide, those of *Burtt & Woods* B1863 and *Mjöberg* 160 are only slightly smaller. In these two specimens the reticulation is less striking and there is a lack of bristles on the upper leaf surface. The description of the species has been expanded to accommodate such strong-growing forms, but the possibility that they will eventually be found to require some taxonomic recognition is not excluded. The remaining citations exhibit leaf measurements which range from 5–6 cm × 2–3·5 cm in *Brooke* 9560 to 11 cm × 6 cm (*Haviland & Hose* 3540).

C. obtusifolium has a similar distribution to *C. subglabrum*, that is S & SW Sarawak and adjacent parts of Kalimantan.

10. Cosmianthemum sp?

KALIMANTAN: Liang gagang [0° 40′ N 113° 10′ E], *Hallier* 2744 (L, K).

Erect herb of up to c. 65 cm, almost entirely glabrous. Leaves shortly petiolate (1–2 mm, rarely up to 5 mm long); lamina c. 7–17 cm long, 1·5–4 cm wide, caudate acuminate at the apex, narrowed towards the abruptly rounded base; linear cystoliths present on both surfaces; main nerves up to c. 15 pairs. Inflorescence terminal, c. 15 cm long (peduncle 2·25 cm). Lower-

most bracts 3 mm long reducing to 0·5 mm apically; cymes many to few flowered those on the lower part of the raceme borne on slender 7 mm peduncles which reduce in size towards the apex. No flowers or fruit seen.

This plant bears certain vegetative resemblances to *C. subglabrum* though the abruptly rounded leaf base is akin to *C. brookeae*. The inflorescence however, is perplexing, for the elongation of the axis of the cyme is not of the thickened "cone-like" nature referred to earlier but much more delicate and would seem unlikely to produce the large capsule of *Cosmianthrmum*. It may be that we are in error in placing it in the genus at all, but in the absence of flower and fruit no reliable conclusion is possible and it may be usefııl to draw attention to the specimen.

INDETERMINABLE SPECIMENS

KALIMANTAN: Pontianak, *Teysmann* 11502 (K). In indumentum and corolla resembling *C. subglabrum* but the cordate leaf bases indicate an affinity with *C. bullatum*.

KALIMANTAN: Landak, Pariet Demah, *Teysmann* 11512 (L). Without date or locality, *Teysmann* 11505 (L). Indumentum of *C. subglabrum* but leaves abruptly rounded at the base. Possibly close to *C. brookeae*. Flower and fruit not seen.

KALIMANTAN: W Koetai, Tanjong Isoir, 3 viii 1925, *Endert* 1902 (L). Allied to *C. latifolium* but lacking the longer petioles of that species.

SABAH: Mt. Kinabalu, Bungal Foothills, 400 m, 25 vi 1932, *J. & M. S. Clemens* 27545 (K, BM). Patelliform glands are a conspicuous feature of the lower leaf surface, but no cystoliths have been observed. Due to inadequate flowering material we have been unable to determine if the corolla tube bears a dorsal pouch. The capsule is 2·3 cm long including the 1·4 cm stipe. This plant may eventually prove to be an interesting new species; Bremekamp suggested that it was allied to *C. angustifolium*, but indumentum and leaf-base recall *C. brookeae* more strongly, though the stipe of the capsule is longer than in that species.

APPENDIX ON POLLEN MORPHOLOGY

D. M. HENDERSON

The following account is based on acetolysed and bleached preparations from herbarium material. The pollen of all the species falls into the same 3-colporate type with the exceptions of *C. bullatum* and *C. anomalum*. In the former a proportion of the grains are 4-colporate but otherwise are very similar to the rest of *Cosmianthemum*. In the only material of *C. anomalum* available colpi are absent and the grains are very irregularly porate; indeed although a description of the grains is given it must not be taken as a description for the species, for the irregular development is almost certainly due to unnatural conditions of the parent plants in cultivation and unfortunately this is the only source available.

1. Cosmianthemum anomalum Burtt & Smith (Burtt 2671—Plate 37, Fig. 6, 7, 8). Pollen grains spheroidal, 38–47μ diameter, apertures very irregular, colpi and colpoid streaks absent, pores 4–6, irregularly equatorial, usually circular, 4–6μ diameter. Exine 3–4μ thick, sexine 1–1·5μ thick, nexine 2–2·5μ thick. Sexine at high focus with irregular labyrinthiform reticulum, simplibaculate, low focus with indistinct free-standing bacula.

2. Cosmianthemum dido Burtt & Smith (Burtt & Woods B1998—Plate 37, Fig. 1, 2.) Pollen grains 3-colporate, prolate, 45–46 × 39μ. Colpoid streaks as in *C. magnifolium*. Sexine 1·2μ thick, nexine 0·5μ thick. High focus of sexine, continuous tectum minutely punctate, lower focus, densely arranged minute bacula.

3. Cosmianthemum bullatum (N.E.Br.) Burtt & Smith (holotype—Plate 37, Fig. 4, 5). Pollen grains 3–4 colporate, spheroidal, 42–48μ diameter, otherwise colpi and colpoid streaks as in *C. angustifolium*. Sexine 1·5–2μ thick, minutely and irregularly reticulate, lumina c. 0·5–1μ diameter at high focus, rather large separate bacula at low. Nexine 1μ thick.

4. Cosmianthemum subglabrum Brem. (Burtt & Woods B1871). Pollen grains 3-colporate, apertures as in *C. angustifolium*. Exine 2·5μ thick, sexine tectate, tectum minutely punctate, nexine 1μ thick.

5. Cosmianthemum brookeae Brem. (Brooke 10681). *C. angustifolium* type. Pollen grains spheroidal. Colpoid streaks not fusing, 30μ long, colpi 40μ long. Polar reticulum c. 0·2μ diameter, mesocolpial reticulum c. 0·2μ diameter. Sexine at high focus reticulate low focus isolated bacula. Reticulum simplibaculate.

6. Cosmianthemum magnifolium Brem. (Brooke 8938). Pollen grains 3-colporate with 6 colpoid streaks, 2 in each mesocolpium, spheroidal 40–47μ diameter. Colpi 22μ long, ora prominent, 8μ diameter. Colpoid streaks 24μ long not uniting at poles. Exine 2·2μ thick. Sexine 1·2μ thick, reticulate at high focus, ± isolated bacula at low focus. Lumina at poles 1–1·2μ diameter; in mesocolpium 0·5μ diameter. Nexine 1μ thick.

8. Cosmianthemum angustifolium Brem. (Brooke 9422). Pollen grains 3-colporate with 6 colpoid streaks, 2 in each mesocolpium, arching over and fusing free of the colpus in the polar region. Grains spheroidal, 45–50μ diameter. Sexine reticulate, lumina at poles c. 1–1·2μ diameter; in mesocolpium c. 0·5–1μ diameter. No isolated bacula observed at low focus of sexine.

9. Cosmianthemum obtusifolium Brem. (Burtt & Woods B1873—Plate 37, Fig. 3). As *C. angustifolium*. Apocolpium very small. Polar lumina of sexine reticulum c. 0·5–1μ diameter, mesocolpial c. 0·5μ diameter.

From these descriptions it is clear that, with the exception of *C. anomalum*, the seven species form a closely related group. Two colpoids streaks occur in each mesocolpium in *C. brookeae*, *C. magnifolium* and *C. dido*, the colpoid

streaks are more or less equal in length to the colpi, whereas in *C. angustifolium*, *C. bullatum*, *C. obtusifolium* and *C. subglabrum* the colpoid streaks unite in pairs in the polar regions of the mesocolpia. Tricolporate grains of this type occur in several tribes of the subfamily Acanthoideae sensu Lindau (Bhoj Raj, in Grana Palynologica 3 (1): 1–108: 1961), notably in Graptophylleae, Pseuderanthemeae and Odontonemeae. Uniting colpoid streaks occur in the genera *Pseuderanthemum* and *Mackaya* which are usually considered allies of *Cosmianthemum*.

KEY TO POLLEN TYPES

Colpi absent . . . . . . *C. anomalum*
Colpi present
  Colpoid streaks not uniting
    Tectum reticulate, pollen grains spheroidal . . *C. magnifolium*
    C. brookeae
    Tectum punctate, pollen grains prolate . . . . *C. dido*
  Colpoid streaks uniting at ends
    Sexine in form of a punctate tectum . . . . *C. subglabrum*
    Sexine variously reticulate
      Lumina of reticulum at poles greater than at mesocolpium
      C. angustifolium
      C. obtusifolium
      Lumina of reticulum at poles and in mesocolpium equal, 3- and 4-colporate grains present . . . . . *C. bullatum*

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